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jc541 U.S. PTO

## UTILITY PATENT APPLICATION TRANSMITTAL

Address to: <b>Box PATENT APPLICATION</b> <b>Assistant Commissioner for Patents</b> <b>Washington, DC 20231</b>	Attorney Docket No. SHEL 0101 PUS	jc511 U.S. PTO 09/454103 12/03/99
	Inventor(s) or Application Identifier: Patrick R. O'Connell	

1. This application entitled FUEL TANK FILLER NECK AND METHOD FOR MANUFACTURING  
SAME is:

- a. ☒ A new application under 37 C.F.R. §1.53(b).
- b. ☐ A ☐ continuation ☐ divisional or ☐ continuation-in-part application under 37 C.F.R. § 1.53(b) of prior application Serial No.        /        filed on       ,  
entitled       .

Application elements and other attached papers:

2. ☒ Specification (incl. Claims and Abstract) [Total Pages 14]
3. ☒ Drawings (☐ informal ☒ formal) [Total Sheets 4]
4. ☒ Oath or Declaration
- a. ☒ Newly-executed
- b. ☐ Copy from a prior application (37 C.F.R. § 1.63(d))
5. ☐ Incorporation By Reference: The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Item 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. ☐ This application is filed by fewer than all the inventors named in the prior application, 37 C.F.R. § 1.53(d)(4).
- a. ☐ **DELETE** the following inventor(s) named in the prior nonprovisional application:
- b. ☐ The inventor(s) to be deleted are set forth on a separate sheet attached hereto.

## CERTIFICATION UNDER 37 C.F.R. § 1.10

I hereby certify that this UTILITY PATENT APPLICATION TRANSMITTAL and the documents referred to as attached therein are being deposited on the below date with the United States Postal Service in an envelope as "Express Mail Post Office to Addressee" addressed to: Box Patent Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

Express  
Mail Label No. EL 450454022 US

Date of Deposit: December 3, 1999

Catherine Nikkila  
(Type or print name of person mailing paper)

Catherine Nikkila  
(Signature of person mailing paper)

EL450454022US

## 7. Preliminary Amendment:

- a. ☐ A Preliminary Amendment is attached.
- b. ☐ Cancel in this application original claims \_\_\_\_\_ of the prior application before calculating the filing fee.
- c. ☐ Please amend the specification by inserting before the first line the sentence:
- "This is a
- ☐ continuation
- ☐ divisional
- of copending application(s)
- \_\_\_\_\_ Serial number \_\_\_\_\_ / \_\_\_\_\_ filed on \_\_\_\_\_."
- d. ☐ A Petition to Suspend Prosecution For The Time Necessary to File An Amendment (New Application Filed Concurrently) is attached.

## 8. Small entity status:

- a. ☒ A small entity statement is attached.
- b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
- c. ☐ Is no longer desired.

## 9. Fee Calculation:

FOR	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS
TOTAL CLAIMS (37 C.F.R. § 1.16(c))	25 -20 =	5	X 18.00	90.00
INDEPENDENT CLAIMS (37 C.F.R. § 1.16(b))	4 -3 =	1	X 78.00	78.00
MULTIPLE DEPENDENT CLAIMS (if applicable) (37 C.F.R. § 1.16(d))			260.00	
			BASIC FEE (37 C.F.R. § 1.16(a))	760.00
Total of above Calculations =				928.00
Reduction by 50% for filing by small entity (Note 37 C.F.R. §§ 1.9, 1.27, 1.28)				464.00
Assignment Recordal Fee			40.00	40.00
TOTAL =				504.00

10. ☒ A check in the amount of \$ 504.00 is enclosed.

11. ☒ The Commissioner is hereby authorized to credit overpayments or charge the following fees (or any deficiency therein) to Deposit Account No. 02-3978:

- a. ☒ Fees required under 37 C.F.R. § 1.16.
- b. ☒ Fees required under 37 C.F.R. § 1.17.

12. Maintenance of Copendency of Prior Application

☐ A request for extension of time and the appropriate fee have been filed in the pending **prior** application (or are being filed in the prior application concurrently herewith) to extend the period for response until \_\_\_\_\_.

13. ☒ An Information Disclosure Statement (IDS) is attached, along with the following indicated attachments thereto:

a. ☒ Form PTO/SB/08 (one sheet(s))

b. ☒ Copies of references cited

14. ☐ Certified copy of priority document(s)

15. ☒ Return Receipt Postcard

16. ☐ Other: \_\_\_\_\_

17. ☒ An Assignment of the invention to Shelby Enterprises, Inc.

a. ☒ is attached.

b. ☐ was recorded on \_\_\_\_\_ at Reel \_\_\_\_\_, Frame \_\_\_\_\_.

18. The power of attorney in the prior application is to:

\_\_\_\_\_  
Name of Attorney of Record

\_\_\_\_\_  
Reg. No.

☐ The power appears in the original papers in the prior application.

☐ The power does not appear in the original papers, but was filed on \_\_\_\_\_.

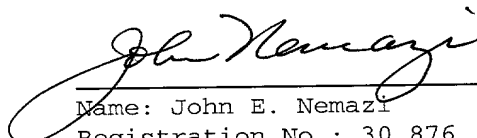
☒ A new power has been executed and is attached.

19. Correspondence Address: Please address all future communications to:

John E. Nemazi,  
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Telephone: 248-358-4400; Fax: 248-358-3351

Respectfully submitted,

Date December 3, 1999

  
\_\_\_\_\_  
Name: John E. Nemazi  
Registration No.: 30,876

☒ Attorney or agent of record  
☐ Filed under Rule 34(a)

**VERIFIED STATEMENT (DECLARATION) CLAIMING SMALL ENTITY STATUS**  
**(37 C.F.R. §§ 1.9(f) and 1.27(c)) - SMALL BUSINESS CONCERN**

           the owner of the small business concern identified below:  
X an official of the small business concern empowered to act on behalf of the concern identified below:  
Name of Concern: Shelby Enterprises, Inc.  
Address of Concern: 70701 Powell Road  
Romeo, MI 48065

I hereby declare that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention, entitled: FUEL TANK FILLER NECK AND METHOD OF MANUFACTURING SAME  
by inventor(s) Patrick R. O'Connell  
described in

  X   the specification filed herewith  
       application Serial No. \_\_\_\_\_, filed \_\_\_\_\_.  
       Patent No. \_\_\_\_\_, issued \_\_\_\_\_

If the rights held by the above-identified small business concern are not exclusive, each individual, concern or organization having rights in the invention is listed below' and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 C.F.R. § 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 C.F.R. § 1.9(d) or a nonprofit organization under 37 C.F.R. § 1.9(e).

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NON-PROFIT ORGANIZATION

NAME \_\_\_\_\_  
ADDRESS \_\_\_\_\_  
[ ] INDIVIDUAL [ ] SMALL BUSINESS CONCERN [ ] NON-PROFIT ORGANIZATION

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 C.F.R. § 1.28(b).)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

Name and Title of Person Signing Anthony Pacitto, Vice President of Operations

Address of Person Signing 70701 Powell Road, Romeo, MI 48065

Signature Cheryl R. Smith Date 11/29/99

## **FUEL TANK FILLER NECK AND METHOD OF MANUFACTURING SAME**

### **TECHNICAL FIELD**

5       The present invention relates to the fuel tank filler neck connected to  
the gas tank of an automobile.

### **BACKGROUND ART**

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10       Gas tank fuel systems with reduced gasoline vapor loss are becoming  
increasingly important in the automobile industry to reduce needless loss of fuel.  
The typical solution to this problem has been to reduce the diameter of at least a  
section of the fuel tank filler neck. Though this approach has been somewhat  
successful, it is limited because as the diameter of the filler neck is decreased, the  
resistance to flow of the gasoline is increased. The increased resistance causes the  
fill neck to become filled during vehicle refueling thereby blocking release of any  
pressure buildup and causing the fuel nozzle to shut off prematurely before the fuel  
15       tank is full.

20       Another disadvantage of such methods of reducing gasoline vapor  
losses is that typically the end of the gas line filler neck is flared out in order to  
provide a sufficient diameter to accept the gas nozzle during refueling. Since the fuel  
tank filler neck is usually fabricated from butt-seam welded tubing, there is an  
increasing tendency for the integrity of the weld to leak as thinner diameter tubes are  
utilized.

### **DISCLOSURE OF INVENTION**

25       The filler neck for receiving a fuel supply nozzle for a motor vehicle  
fuel tank includes a one-piece seamless funnel member having a tubular body. The  
funnel member defines in off-set axial relation a relatively large inlet opening adapted  
for attachment to a receptor for the nozzle and a relatively small necked down outlet

opening adapted for attachment to the inlet of an elongated tubular member in communication with the fuel tank. The offset relationship of the inlet and outlet opening induces a swirling motion in the fuel flow as the fuel proceeds towards the fuel tank. The resultant swirl motion of the flowing fuel leaves an opening through which any pressure buildup in the fuel tank may be vented. The spiraling motion of the fuel through the narrow elongated tube member also assists in preventing fuel vapors from escaping during refueling because of an induced suctioning effect that is created by the spiraling motion of the fuel through a narrow cavity.

In another embodiment of the invention, the seamless funnel member is drawn and provided with an attachment portion adjacent to the inlet opening for attaching a gas nozzle receptor to the funnel member. The seamless surface of the filler neck allows for the receptor to protrude into the filler neck and form a seal to the inner surface of the filler neck.

In still another embodiment of the invention, the seamless funnel member is attached to the elongated member inlet by either a braised joint, an adhesive joint, or a resistance welded joint.

In yet another embodiment of the invention, the seamless filler neck is provided with an anti-corrosive coating.

In the preferred embodiment of the invention, the relatively large diameter section forming the inlet opening into which the gas nozzle is positioned and a spaced-apart relatively smaller diameter tubular section forming the outlet opening are in an axially offset relationship. These tubular sections are connected to one another by a tapered section which gradually blends from the large diameter section to the small diameter section. In a refinement of this embodiment, the tapered section intersects the large diameter section at an elliptically-shaped junction which lies in a plane inclined  $60-85^\circ$  from the axis of the tubular sections. In a further refinement of this embodiment, the funnel inlet opening has a diameter  $D_1$  and the tubular section has a diameter  $D_2$  with a coaxial offset at a distance  $X$  where  $.1D_2$  is less than  $X$  which is less than  $.3D_2$ , and where  $D_1$  is at least one and a half

times  $D_2$ . In yet another refinement of this embodiment of the invention, the funnel inlet axial offset is sufficient to achieve fuel swirl during fuel filling.

In another embodiment of the invention, the funnel inlet opening has a diameter  $D-1$  and the outlet opening has a diameter  $D-2$  where  $D-1$  is at least one and a half times  $D-2$ . In a refinement of this embodiment,  $D_2$  is less than 35 mm. In a further refinement of this embodiment,  $D_2$  is less than 30 mm.

This invention also includes a method of manufacturing the filler neck for a motor vehicle fuel tank. First, the filler neck is formed by deep-drawing a seamless funnel member having an elongated tubular body with an enlarged inlet at one end and a relatively small outlet at the opposite end. A length of butt-seam tubing is cut to form a tubular member of desired length. An end of the tubular member is telescopically aligned with the outlet of the funnel member to securely join the funnel and tubular members together. The tubular member is bent to a desired shape. A nozzle receptor is attached to the funnel member adjacent the funnel inlet. In a refinement of the method, the configuration is then leak tested to verify the integrity of joining the funnel member to the tubular member and the attachment of the nozzle receptor to the funnel member, and the integrity of the butt-seam joint and the tubular member subsequent to bending. The funnel member is attached to the tubular member by braising, adhesive bonding, or welding. In yet another refinement of the method, a portion of the filler neck is configured to induce a sufficient swirl to create a hollow passage for suctioning fuel vapors to prevent their escape during refueling and to provide a vent passage for any pressure buildup in the fuel tank.

Accordingly, it is an object of the present invention to provide an improved fuel tank filler neck.

Another object of the present invention is to provide an improved fuel tank filler neck that inhibits the escape of gasoline vapors from the fuel tank.

Still another object of the present invention is to provide an improved fuel tank filler neck that is inexpensive to fabricate.

Still another object of the present invention is to provide an improved fuel tank filler neck that vents pressure buildup created in the fuel tank during refueling.

5 Still another object of the present invention is to provide an improved fuel tank filler neck that does not leak.

Yet another object of the present invention is to provide an improved method for fabricating the fuel tank filler neck of the foregoing objects.

Another more specific object of the invention is a method for forming a filler neck for a motor vehicle fuel tank by deep-drawing a seamless funnel member  
10 having an elongated tubular body with an enlarged inlet at one end and a relatively small outlet at the opposite end. A length of butt-seam tubing is cut to form a tubular member of desired length. An end of the tubular member is telescopically aligned with the outlet of the funnel member and securely joining the funnel and tubular members together. The tubular member is bent to a desired shape. A nozzle receptor  
15 is attached to the funnel member adjacent the funnel inlet.

Another more specific object in the method of the last mentioned object includes a portion of the filler neck configured to induce a sufficient swirl to create a hollow passage for venting vapors from the gas tank during fuel filling.

In carrying out the above objects and other objects and features of the  
20 present invention, a fuel tank filler neck is described in a mounting relationship to the vehicle fuel tank. The fuel tank filler neck and the method for its manufacture provide advantages to an automobile manufacturer by reducing escape of gasoline vapors from the fuel tank, by permitting simple manufacturing of the filler neck, and by reducing attendant costs.

25 The above objects and other objects, features, and advantages of the present invention are readily apparent from the following detailed description of the



best mode for carrying out the invention whin taken in connection with the accompanying drawings.

### **BRIEF DESCRIPTION OF DRAWINGS**

FIGURE 1 is a schematic of a fuel tank filler neck incorporated in a  
5 automobile fuel tank system;

FIGURE 2 is a fragmented cross sectional view of the fuel tank filler neck and an attached elongated member in the fuel tank system of Figure 1 according to one embodiment of the present invention;

FIGURE 3 is a schematic dimensional view of the filler neck as a  
10 funnel member according to an embodiment of the present invention;

FIGURE 4 is a cross sectional view of a rolled over top modification of the fuel tank filler neck according to another embodiment of the present invention;

FIGURE 5 is a cross sectional view of a barbed end design of the fuel  
15 tank filler neck according to another embodiment of the present invention;

FIGURE 6 is a cross sectional view of a hose bead modification of the fuel tank filler neck according to another embodiment of the present invention; and

FIGURES 7a-7i are schematic illustrations of the method steps for making the fuel tank filler neck of this invention.

## BEST MODE FOR CARRYING OUT THE INVENTION

### ARTICLE

With reference to Figure 1 a schematic of an embodiment of fuel tank filler neck 2 incorporated into automobile fuel tank system 4 is provided. Filler neck 2 for receiving fuel nozzle 6 for a motor vehicle fuel tank includes a one-piece funnel member 8 having a tubular body. One end of funnel member 8 is defined by inlet opening 10 which is attached to nozzle receptor 12. Gas cap 14 screws directly into nozzle receptor 12. Fuel tank system 4 attaches to automobile body 16 through opening 18. Movable cover 20 conceals gas cap 14 when the vehicle is not being refueled. The other end of funnel member 8 is defined by outlet opening 22 that is attached to elongated tube member 24. Elongated tube member 24 attaches to fuel tank 26. During refueling gas cap 14 is removed and gas nozzle 6 is inserted into nozzle receptor 12. Fuel flows out of gas nozzle 6 into funnel member 8. Funnel member 8 induces a swirling motion in the fuel as the fuel proceeds to flow into elongated tube member 24. The swirling motion of the fuel continues as the fuel fills fuel tank 26. The swirling motion of the fuel created by funnel member 8, creates a suctioning effect that prevents fuel vapors from escaping into the atmosphere during refueling. The swirling motion of the fuel, also creates a central void that allows any pressure buildups created during refueling to vent thereby preventing premature shutoff of the fuel nozzle. Vent tube 25 connects to funnel member 8 at funnel vent hole 27 and to fuel tank 26 at fuel tank hole 29. Vent tube 27 allows displaced vapors in fuel tank 26 to be vented during refueling. The venting configuration defined by vent tube 27 may be replaced by a system that recirculates the fuel vapor. Such system are known to individuals skilled in the art.

With reference to Figures 1 and 2, funnel member 8 defines in off-set axial relation a relatively large inlet opening 10 adapted for attachment to a gas nozzle receptor 12 and a relatively small necked down outlet opening 22 adapted for attachment to inlet 28 of elongated tubular member 24. The off-set axial relation between the inlet opening 10 and outlet opening 22 causes fuel emerging from gas nozzle 6 to impinge on side 30 of funnel member 8 and thereby causes fuel to spiral

as the fuel proceeds forward to elongated tube member 24. Gas cap 14 screws directly into gas nozzle receptor 6. Filler neck 2 may optionally be provided with vent opening 27 for attachment to vent tube 25. Vent opening 27 may either be drilled in funnel member 8 after it drawn or it may be incorporated in the sheet stock before funnel member 8 is drawn. Funnel member 8 is drawn and is therefore seamless. Funnel member 8 is provided with an cutouts 30, 32 adjacent to inlet opening 10 for attaching the nozzle receptor 6 to funnel member 8. Cutouts 30,32 allow nozzle receptor 6 to snap into position via wings 34, 36 that protrude out of nozzle receptor 6. Because funnel member 8 is seamless, insert section 38 of nozzle receptor 6 is able to make intimate contact with funnel member 8 thereby creating a leak-proof seal via O-ring 40. Funnel member 8 is attached to the elongated member inlet 28 by braised joint 42. Optionally, filler neck 2 may be coated with an anti-corrosive coating 44.

With reference to Figure 3, relatively large diameter section 46 forming the inlet opening 10 and the spaced-apart relatively smaller diameter tubular section 48 forming the outlet opening 22 are in an axially offset relationship. The large diameter section 46 and the small diameter tubular section 48 are connected to one another by tapered section 50 which gradually blends from the large diameter section 46 to the small diameter section 48. Tapered section 50 intersects large diameter section 46 at elliptically-shaped junction 52 which lies in a plane inclined at angle A which is 60-85° from the axis of the tubular sections. The funnel inlet opening 10 has a diameter  $D_1$  of 60 mm and the tubular section has a diameter  $D_2$  of 25 mm with a coaxial offset at a distance X which is 15 mm. This offset axial relationship is sufficient to achieve fuel swirl during fuel filling.

With reference to Figure 4, a modification of filler neck 2 is illustrated. Rolled over top 54 is formed at the top of large diameter section 46. In this modification, rolled over top 54 provides a sealing surface onto which gas cap 14 makes a seal. Gas cap 14 screws directly into nozzle receptor 12. Nozzle receptor 12 is held in position by crimps 56, 58 which project into indentations 60, 62 in nozzle receptor 12.

With reference to Figure 5, a modification of filler neck 2 is illustrated. The surface of the smaller diameter tubular section 48 is provided with barbs 64, 66, 68. This modification allows for plastic or rubber tubing to be utilized for the formation of elongated tube member 24.

5                   With reference to Figure 6, a modification of filler neck 2 is provided. The surface of the smaller diameter tubular section 48 is provided with hose bead 70. This modification allows for plastic or rubber tubing to be utilized for the formation of elongated tube member 24.

### METHOD

10                   The method of manufacturing the fuel tank filler neck of this invention will now be described with reference to Figures 1, 2, 3 and 7. First, the filler neck 2 for motor vehicle fuel tank system 4 is formed by deep-drawing a seamless funnel member 8 having an elongated tubular body 24 with an enlarged inlet opening 10 at one end and a relatively small outlet opening 22 at the opposite end. A length of butt-

15                   seam tubing is cut to form a tubular member 24 of desired length. An end of the tubular member is telescopically aligned with outlet opening 22 of funnel member 8 and securely joining the funnel and tubular members together. Elongated tubular member 24 is bent to a desired shape. Nozzle receptor 12 is attached to funnel member 8 adjacent funnel inlet opening 10. In a refinement of this embodiment, the

20                   configuration is then leak tested to verify the integrity of joining funnel member 8 to tubular member 24 and the attachment of nozzle receptor 12 to funnel member 8, and the integrity of the butt-seam joint 42 and the tubular member 24 subsequent to bending. The funnel member 8 is attached to the tubular member 24 by braising, adhesive bonding, or welding. In yet another refinement of this embodiment, a

25                   portion of the filler neck 2 is configured to induce a sufficient swirl to create a hollow passage for suctioning fuel vapors into the tank 26 and to allow venting of any pressure buildup during in fuel tank 26 during refueling.

With reference to Figure 7, schematic illustrations of the method steps for making the fuel tank filler neck of this invention and attaching the elongated tube



**WHAT IS CLAIMED IS:**

1                    1.        A filler neck for receiving a fuel supply nozzle for a motor  
 2        vehicle fuel tank comprising:  
 3                    a one-piece seamless funnel member having a tubular body  
 4        defining in off-set axial relation to each other a relatively large inlet opening adapted  
 5        for attachment to a receptor for positioning the nozzle with respect to the large inlet  
 6        opening and a relatively small necked down outlet opening adapted for attachment  
 7        to the inlet of an elongated tubular member in communication with the fuel tank, the  
 8        positioning of the nozzle in combination with the offset axial relation inducing a  
 9        sufficient swirl to the fuel being supplied so as to create a sufficient vacuum to  
 10       prevent fuel vapors from escaping into the atmosphere.

1                    2.        The filler neck of claim 1 wherein the inlet opening is rolled  
 2        over to create a surface to seal to the gas cap.

1                    3.        The filler neck of claim 1 wherein the small necked down  
 2        outlet opening is barbed to adapt the opening for attachment to a plastic tube insert.

1                    4.        The filler neck of claim 1 wherein the small necked down  
 2        outlet opening is formed into a hose bead to adapt the opening for attachment to a  
 3        hose.

1                    5.        The filler neck of claim 1 further comprising a vent hole  
 2        adapted for connection to a fuel tank vent tube.

1                    6.        The filler neck of claim 1 including the receptor and wherein  
 2        the funnel member is drawn and provided with an attachment portion adjacent to the  
 3        inlet opening for attaching the receptor to the funnel member.

1                    7.        The filler neck of claim 1 including the inlet of the elongated  
 2        member and wherein the funnel member is joined to the elongated member inlet by  
 3        a braise.

1                    8.     The filler neck of claim 1 including a tubular member and  
2     wherein the funnel member is joined to the tubular member inlet by adhesive.

1                    9.     The filler neck of claim 1 including a tubular member and  
2     wherein the funnel member is joined to the tubular member inlet by a resistance  
3     weld.

1                    10.    The filler neck of claim 1 including a tubular member and  
2     wherein the funnel member is joined to the tubular member inlet by a weld.

1                    11.    The filler neck of claim 1 including an exterior surface on the  
2     filler neck and wherein substantially all of the exterior surface of the filler neck is  
3     provided with an anti-corrosive coating.

1                    12.    The filler neck of claim 1 wherein the funnel member further  
2     comprises:

3                                a relatively large diameter section forming the inlet opening  
4     and a spaced-apart relatively smaller diameter tubular section forming the outlet  
5     opening wherein the axially offset large diameter and small diameter tubular sections  
6     are connected to one another by a tapered section which gradually blends from the  
7     large diameter section to the small diameter section.

1                    13.    The filler neck of claim 12 wherein the tapered section  
2     intersects the large diameter section at an elliptically-shaped junction which lies in  
3     a plane inclined 60-85° from the axes of the tubular sections.

1                    14.    The filler neck of claim 12 wherein the funnel inlet opening  
2     has a diameter  $D_1$  and the tubular section has a diameter  $D_2$  with a coaxial offset at  
3     a distance  $X$  where  $.1D_2$  is less than  $X$  which is less than  $.3D_2$ , and where  $D_1$  is at  
4     least one and a half times  $D_2$ .

1                    15.    The filler neck of claim 14 wherein the funnel inlet axial offset  
2                    is sufficient to achieve fuel swirl during fuel filling.

1                    16.    The filler neck of claim 1 wherein the funnel inlet opening has  
2                    a diameter D-1 and the outlet opening has a diameter D-2 where D-1 is at least one  
3                    and a half times D-2.

1                    17.    The filler neck of claim 16 wherein  $D_2$  is less than 35 mm.

1                    18.    The filler neck of claim 16 wherein the  $D_2$  is less than 30 mm.

1                    19.    A method of forming a filler neck for a motor vehicle fuel tank  
2                    comprising:

3                                deep-drawing a seamless funnel member having an elongated  
4                    tubular body with a relatively large inlet at one end and a relatively small outlet at  
5                    the opposite end.

6                                cutting a length of butt-seam tubing to form a tubular member  
7                    of desired length;

8                                telescopically joining an end of the tubular member with  
9                    respect to the outlet of the funnel member to securely join the funnel and tubular  
10                   members together;

11                               bending the tubular member to the desired shape; and

12                               attaching a nozzle receptor to the funnel member adjacent the  
13                   funnel member inlet.

1                    20.    The method of claim 19 further comprising leak testing the  
2                    filler neck to verify the integrity of joining the funnel member to the tubular member  
3                    and the integrity of attaching the nozzle receptor to the funnel member, and the  
4                    integrity of the butt-seam tubing of the tubular member subsequent to bending the  
5                    tubular member to the desired shape.

1                    21.    The method of claim 19 wherein the funnel member is joined  
2                    to the tubular member by braising.



1                   22.    The method of claim 19 wherein the funnel member is joined  
2   to the tubular member by adhesive bonding.

1                   23.    The method of claim 19 wherein the funnel member is joined  
2   to the tubular member by welding.

1                   24.    A method of filling a gas tank with fuel from a tubular member  
2   comprising:  
3                                configuring at least a portion of the tubular member such that  
4   the configuration induces a sufficient swirl to create a hollow passage for venting  
5   vapors from the gas tank during fuel filling; and  
6                                filling the gas tank with fuel.

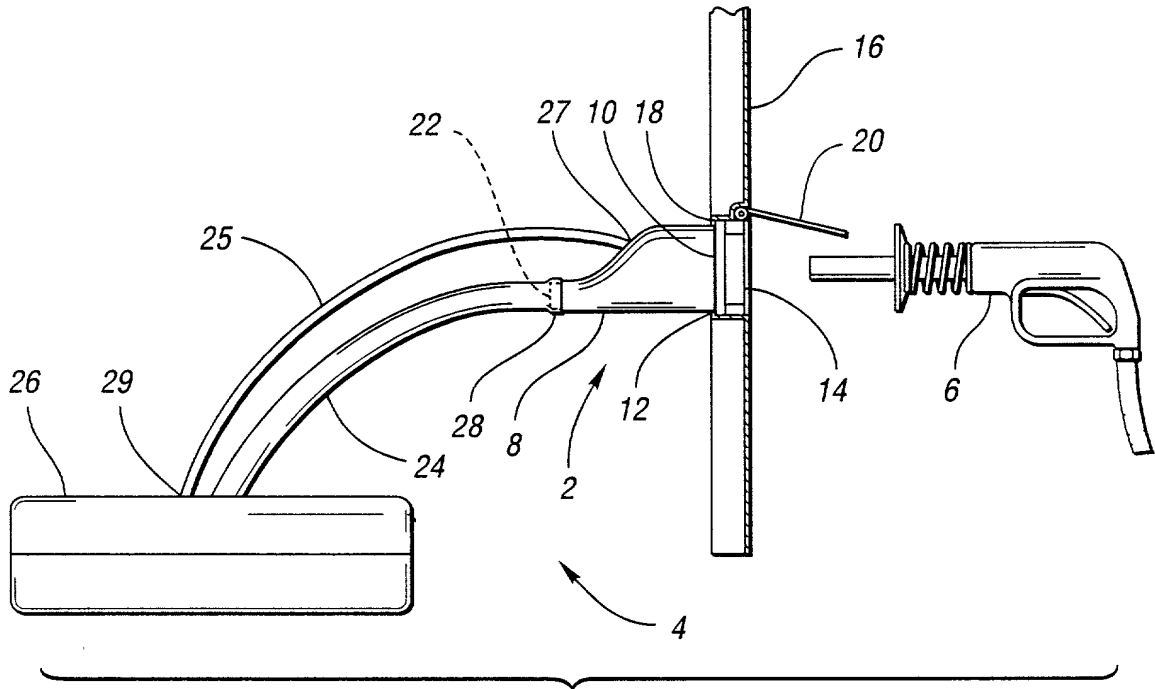
1                   25.    A filler neck for receiving a fuel supply nozzle for a motor  
2   vehicle fuel tank comprising:  
3                                a one-piece seamless funnel member having a tubular body  
4   defining a relatively large inlet opening adapted for attachment to a receptor for  
5   positioning the nozzle with respect to the large inlet opening and a relatively small  
6   necked down outlet opening adapted for attachment to the inlet of an elongated  
7   tubular member in communication with the fuel tank.

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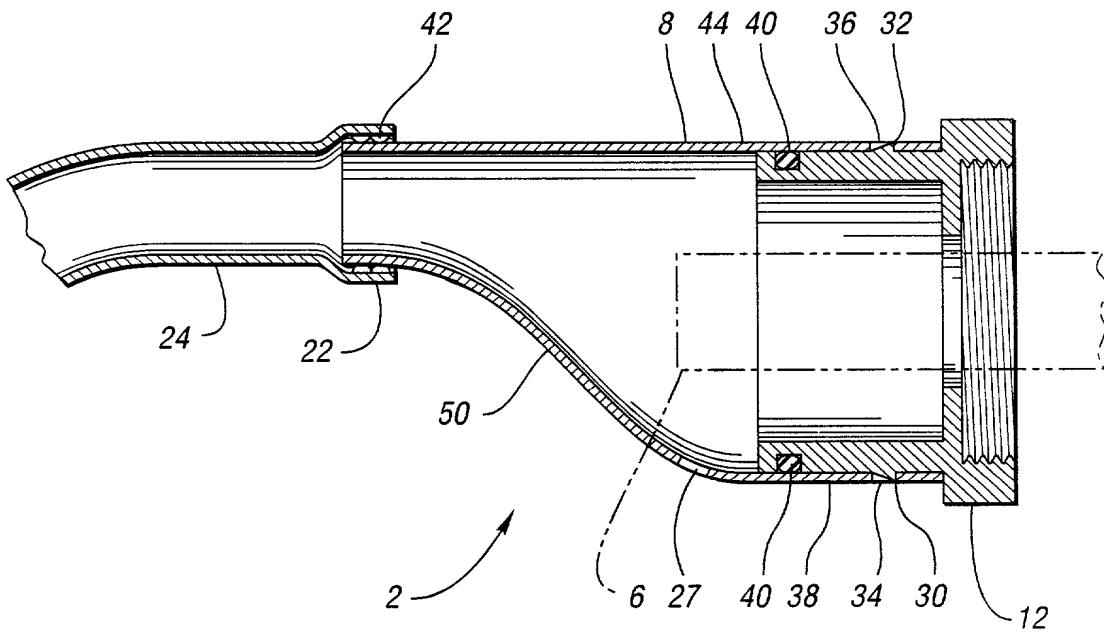
## ABSTRACT OF THE DISCLOSURE

A fuel tank filler neck is provided to reduce the escape of gasoline vapor from an automobile fuel tank system and is leak tight. The filler neck is configured to receive a fuel supply nozzle. The filler neck includes a one-piece  
5 seamless funnel member having a tubular body and an elongated tubular member. The funnel member defines in off-set axial relation a relatively large inlet opening adapted for attachment to a receptor for the nozzle and a relatively small necked down outlet opening adapted for attachment to the inlet of an elongated tubular member. The tubular member is adapted to be in communication with the fuel tank.  
10 A method for manufacturing the fuel tank filler neck is also disclosed.

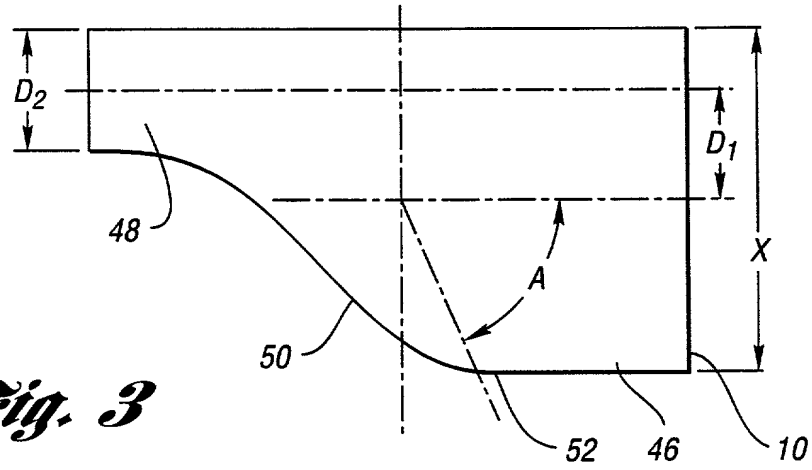
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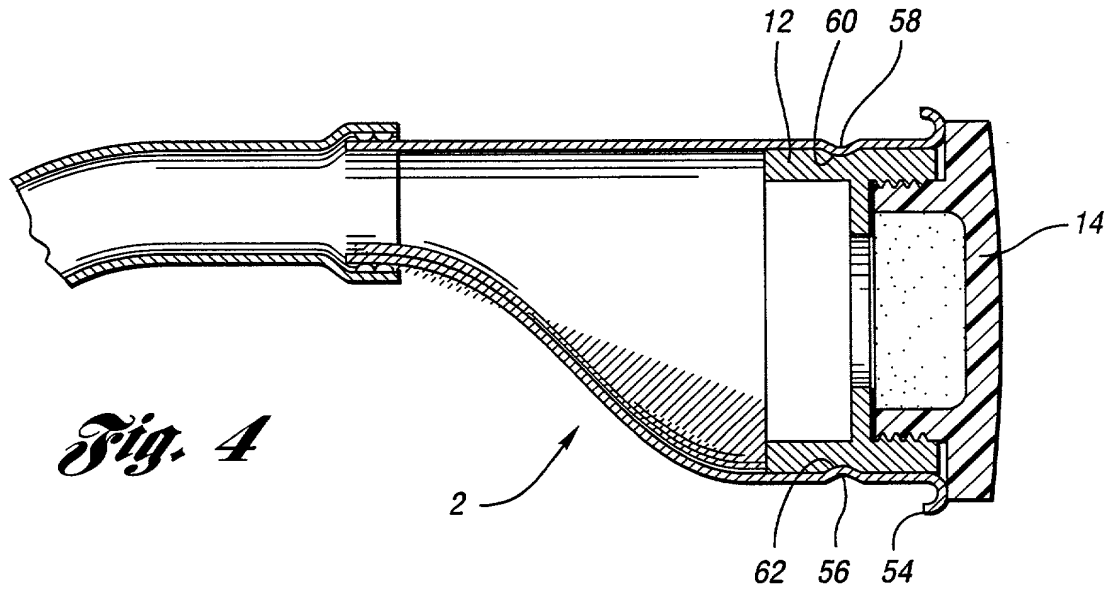
*Fig. 1*



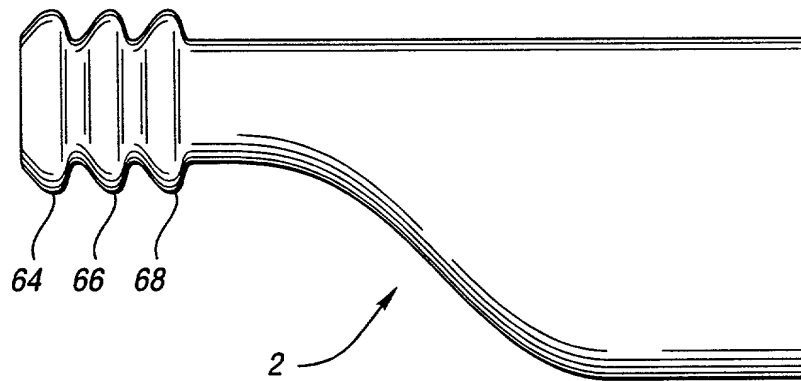
*Fig. 2*



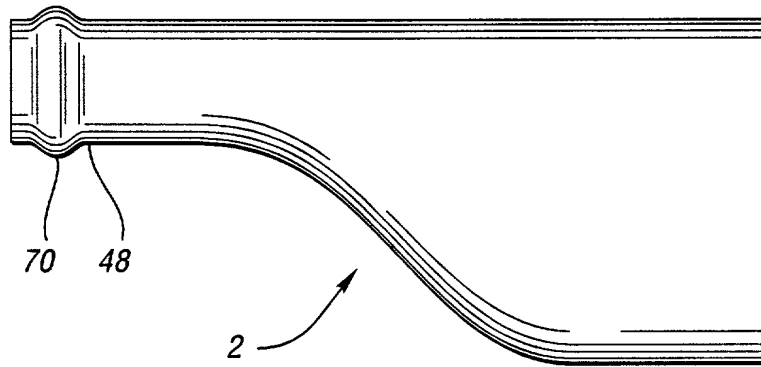
*Fig. 3*



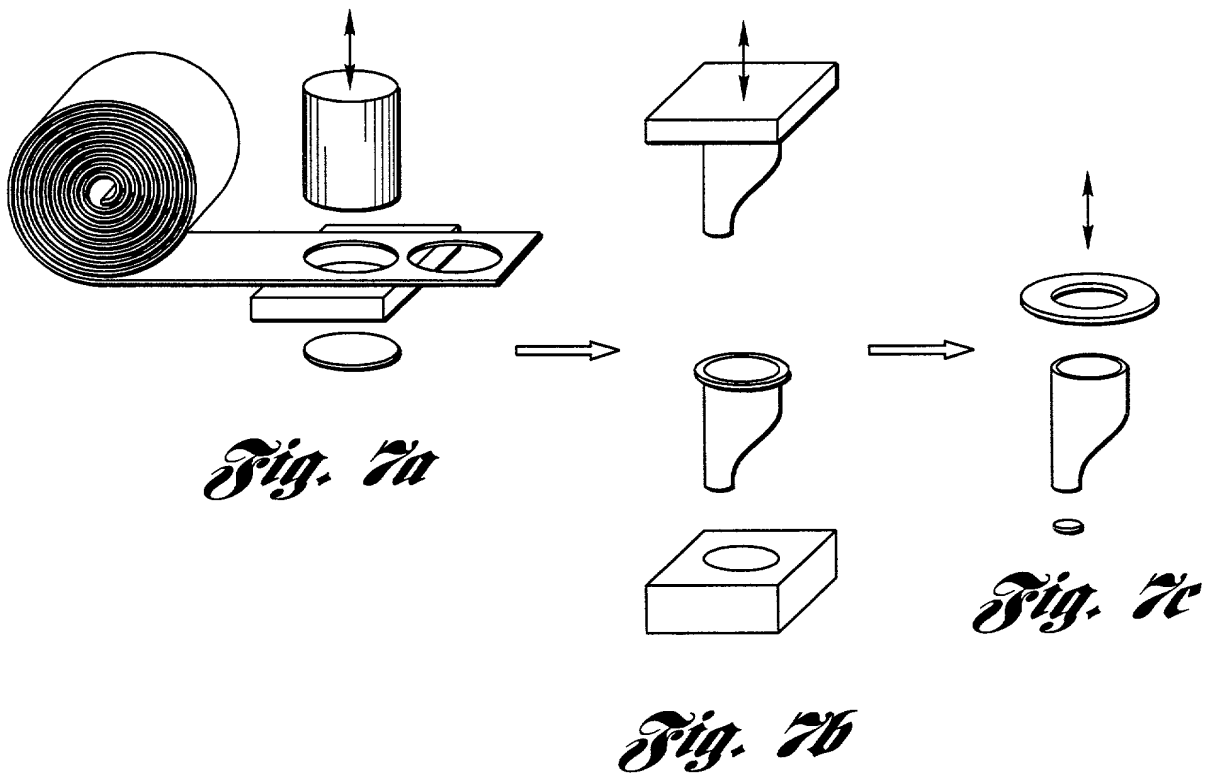
*Fig. 4*



*Fig. 5*



*Fig. 6*



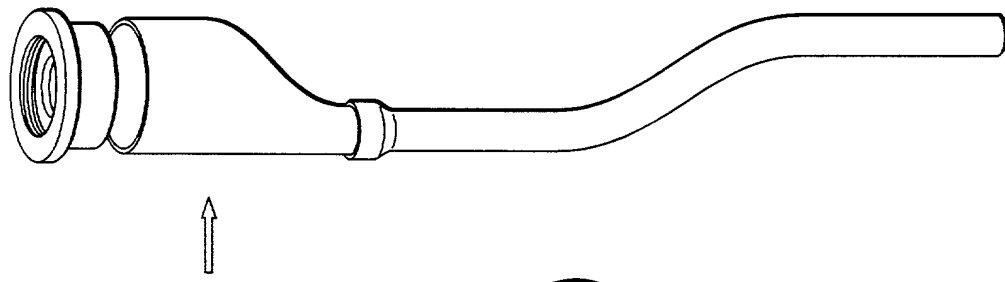
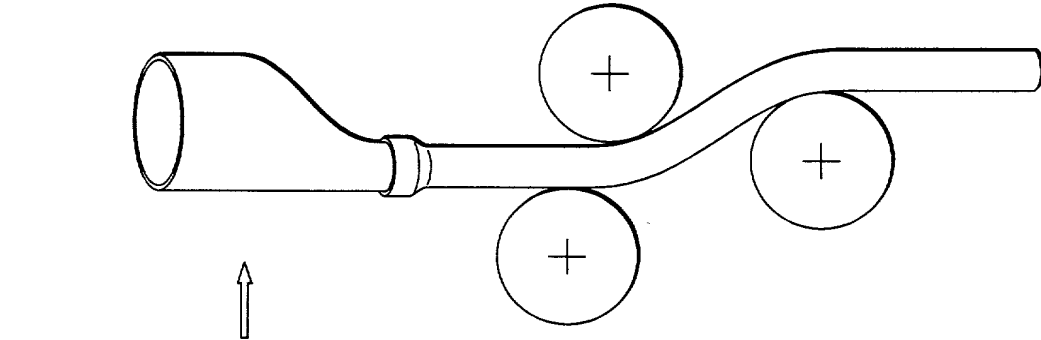
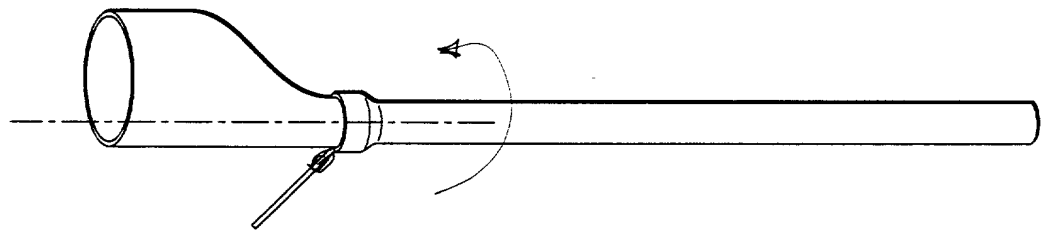
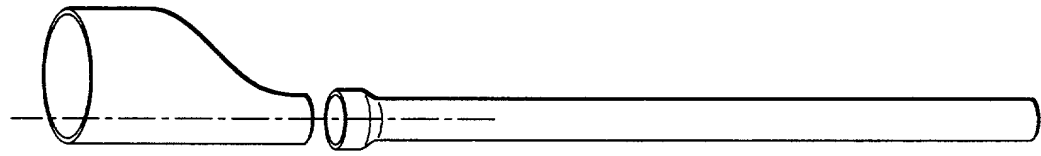
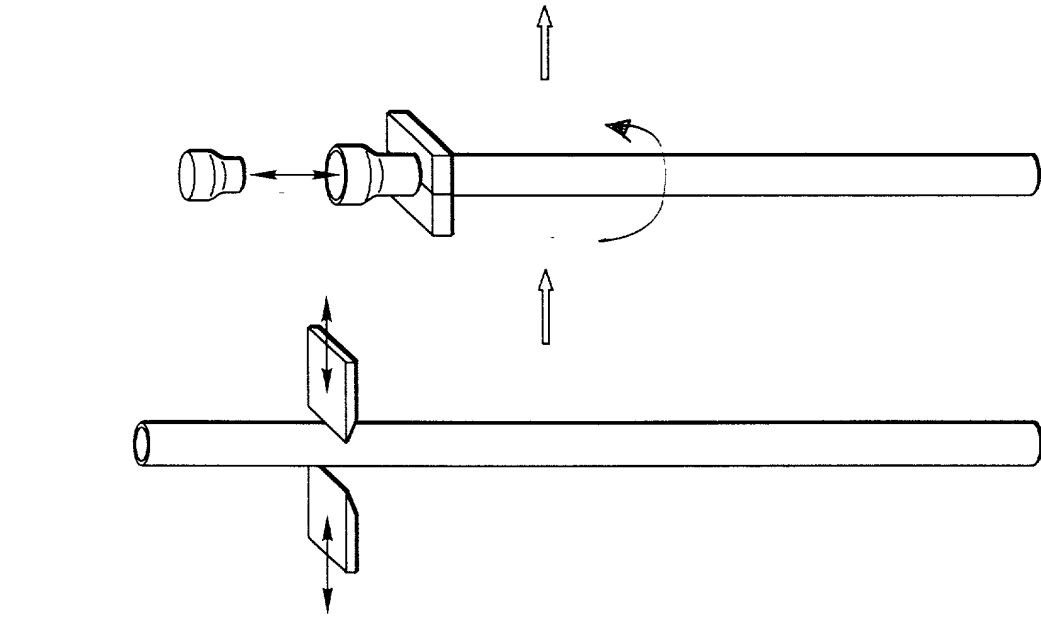


Fig. 20

Fig. 21

Fig. 22

Fig. 23

Fig. 24

Fig. 25

## DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY

Atty. Docket No. SHEL 0101 PUS  
First Named Inventor Patrick R. O'Connell

As a below named inventor, I hereby declare that my residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

### FUEL TANK FILLER NECK AND METHOD OF MANUFACTURING SAME,

the specification of which:

☒ is attached hereto; or  
☐ was filed on (MM/DD/YYYY) \_\_\_\_\_ as U.S. Application Number or PCT International Application Number \_\_\_\_\_, and was amended on (MM/DD/YYYY) \_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) or § 365(b) of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below, and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

<i>Prior Foreign Application Number(s)</i>	<i>Country</i>	<i>Foreign Priority Date (MM/DD/YYYY)</i>	<i>Priority Not Claimed</i>	<i>Certified Copy Attached? (Yes/No)</i>

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below.

<i>Application Number(s)</i>	<i>Filing Date (MM/DD/YYYY)</i>

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

<i>Application Number(s)</i>	<i>Filing Date (MM/DD/YYYY)</i>	<i>Status: Patented, Pending, Abandoned</i>

**Declaration for Patent Application (cont'd.)**Atty. Docket No. SHEL 0101 PUS

I hereby appoint the following registered practitioners to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_

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Residence \_\_\_\_\_ Citizenship \_\_\_\_\_

**Full Name of Third Joint Inventor** \_\_\_\_\_

Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_

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Residence \_\_\_\_\_ Citizenship \_\_\_\_\_

**Full Name of Fourth Joint Inventor** \_\_\_\_\_

Inventor's signature \_\_\_\_\_ Date \_\_\_\_\_

Post Office Address \_\_\_\_\_

Residence \_\_\_\_\_ Citizenship \_\_\_\_\_